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THz generation and single shot detection in a single-crystal layout

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THz generation has been appreciably reported in several non-linear second order crystals owing to their non-linear coefficient value and wide transparency in the optical and THz domain. Optical rectification (OR) is a second order nonlinear process which has been used to explain the mechanism by which THz pulses are generated in these nonlinear crystals such as ZnTe. The passage of an ultra-short pulse through a non-linear crystal, gives rise to polarization term, which at moderate intensity results to difference frequency mixing of two frequency components within the spectral bandwidth of the laser pulse thereby generating low frequency signal within the THz region¹. Usually a similarly thinner crystal is utilized in the electro optic sampling technique for the detection of the THz signal. Only a few THz related papers have explored the option of detecting the THz pulse in the same crystal deployed for generation, of which the THz is sampled by a short probe beam in a multi-shot pattern^{2,3}. To the best of our knowledge, the single-shot detection scheme has not been incorporated in the single-layout configuration. In the single-shot geometry, the THz pulse which is generated in the leading part of the crystal by the incident pump beam, becomes superimposed on a chirped probe beam passing through the crystal. The cost effectiveness and less cumbersome of this scheme prompted the quest of our research. In this work, we study the generation and detection of THz pulse in the single-crystal configuration with respect to a seemingly single shot measurement, pump-probe power ratio effect and comparison of the vertical and horizontal polarized THz signal. The experimental set-up as sketched in Fig. 1.0(a) consist of a 5.2 ps FWHM chirped probe and 3.6 ps FWHM pump beam originating from an 800 nm-centered Ti: Sapphire laser, and focused in the crystal with energy of few tens of μJ . The temporal profile of the retrieved THz pulse as shown in Fig. 1.0(b) corresponds to a narrow spectral width, which extended from few GHz to 500 GHz. The effect of two photon absorption was minimized by rotating the polarization of the pump beam following the suggestion of [3]. Our configuration is not only interesting to investigate the properties of nonlinear crystals but it allows highlighting some additional effects and associated non-linearities by monitoring the influence of the probe beam intensity.

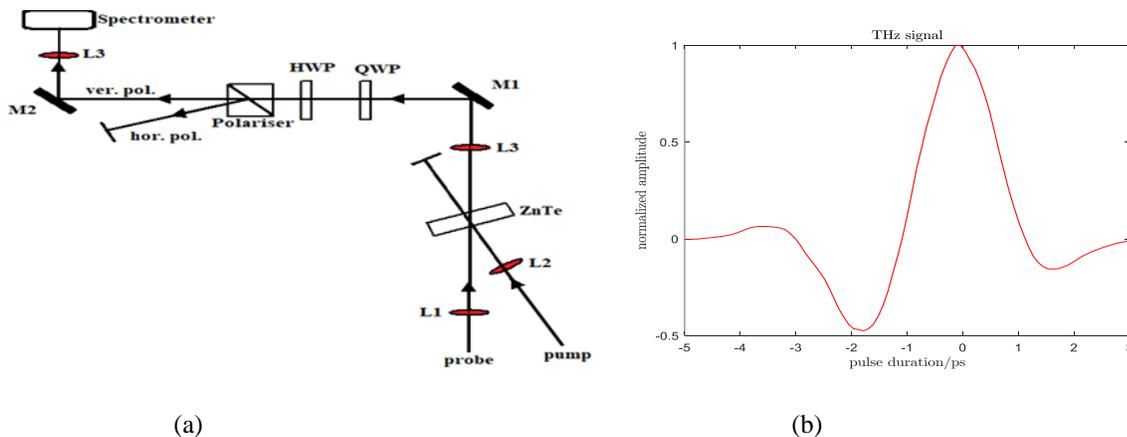


Fig.1.0 a). Sketch of the experimental set-up. b). THz pulse retrieved from the electro optic detection with a single shot geometry.

Reference

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